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**Finch Beak Evolution Graphing and Statistics Activity – Part 1**

AP Biology, Ms. OK, 2014-2015

*Note: This activity is modified from an original activity created by HHMI Biointeractive. I do not claim any rights to the original activity.*

**Introduction**

Relatively few researchers have been able to witness evolutionary change in their lifetimes; among them are Peter and Rosemary Grant. The short film The Beak of the Finch focuses on the Grants’ 40-year study of the finches of the Galápagos Islands. In 1973, the Grants began observing and studying finches on several islands in the Galápagos archipelago. They wanted to understand how species change over time and, in particular, how changes in the environment can influence a species’ physical characteristics.



As part of their work, the Grants intensively studied the population of medium ground finches (Geospiza fortis) on the island of Daphne Major. Every year, the Grants measured the wing length, body mass, and beak size of hundreds of individual medium ground finches. They focused on these characteristics because they vary widely among individual birds within the same species –for example, some birds in a population will be larger than other birds or have bigger beaks, even though they all belong to the same species. It is normal for heritable traits to vary among individuals in a population because no two individuals, except for twins, are genetically identical. In some cases, individuals with one form of a trait, such as a larger beak, will have a survival advantage over individuals with a different form of the trait, such as a smaller beak. Those advantageous traits may make it more likely for some individuals to survive and produce more offspring, and therefore are more likely to be passed on to the next generation. This process is what Charles Darwin called natural selection.

In the film The Beak of the Finch the Grants described the findings from their research: When the weather changed drastically on the island of Daphne Major, individuals with a particular beak size were more likely to survive. In this activity, you will analyze some of the actual measurements that Peter and Rosemary Grant collected. You will interpret their data and suggest hypotheses to explain their observations. In addition, you will use their data to construct graphs and learn why it was important for the Grants to collect data on so many birds. Finally, you will propose how and why some characteristics are more likely than others to change from one generation to the next under specific environmental conditions.

**Procedure**

***Part A: Introducing the Data Set***

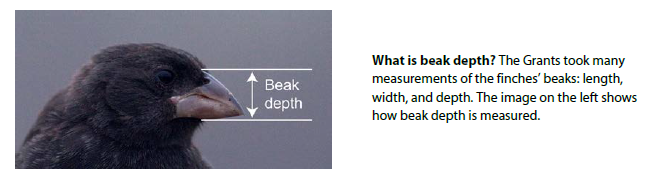
Every year for 40 years, Peter and Rosemary Grant carefully measured the physical characteristics of hundreds of individual medium ground finches living on the island of Daphne Major. In an accompanying Excel spreadsheet, the Grants have provided the measurements they took in a sample of 100 birds born between 1973 and 1976.

For this part of the activity, you should familiarize yourself with the dataset, as instructed by your teacher.

Note that the sample provided by the Grants includes 50 ground finches that lived until 1977. That year, an 18-month-long drought began that resulted in the death of more than 80% of the medium ground finches on the island. The other 50 finches in the dataset survived the drought and lived to 1978 and beyond.

***Part B: Analyzing Graphical Data***

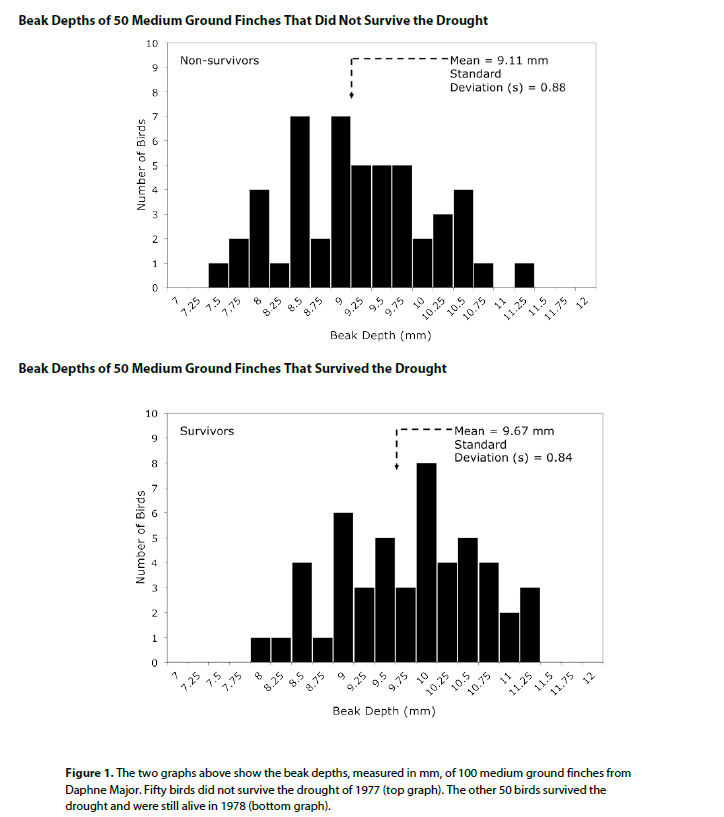
Although you may have been able to see some differences between the two groups of birds by looking at the data in the spreadsheet, one way to more clearly visualize such differences is to graph the data. Figure 1 shows two graphs of beak depth measurement for the 50 medium ground finches that died in 1977 and did not survive the drought (nonsurvivors) and the 50 medium ground finches that lived beyond 1977 and survived the drought (survivors).



Each graph includes **average (mean)** beak depth and **standard deviation (s)** for that group of birds.

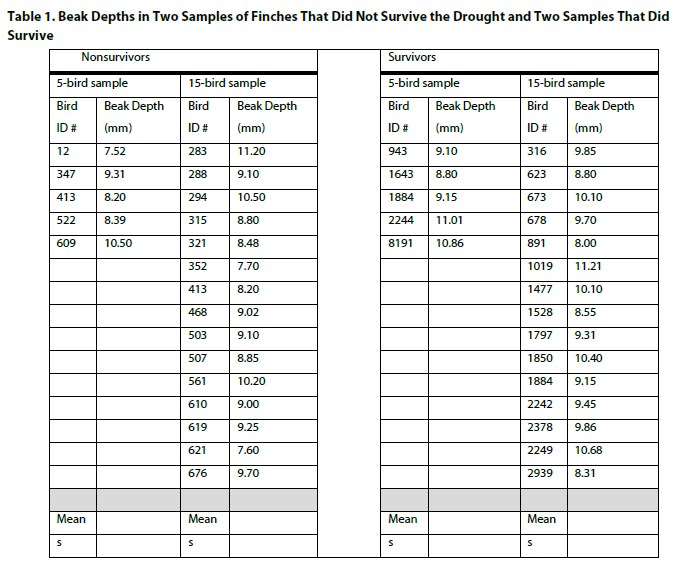
Standard deviation quantifies the amount of variation in a set of measurements. Simply put, it is a measure of how spread out the numbers are, or how much individual data values typically differ from the mean. The larger the standard deviation, the more the data points are spread out for a measured characteristic, such as beak depth, in a population. In the two graphs in Figure 1, the standard deviations are 0.88 and 0.84, meaning that most birds in the first sample have beak depths that are plus or minus 0.88 mm of the mean of 9.11 mm and most birds in the second sample have beak depths that are plus or minus 0.84 mm of the mean of 9.67 mm.

Study the information provided in the graphs and then answer questions 1–4 on your answer sheet. To answer some of the questions, you will need to recall from the film what major change occurred on the island as the drought progressed.



***Part C: Examining the Importance of Sample Size***

The Grants measured beak depths of hundreds of birds every year, and this extraordinary effort was critical to their discoveries. But why was it important for the Grants to collect data on so many birds? What if the Grants had collected data from far fewer birds? Instead of hundreds of birds, assume that they only collected data from either 5 or 15 birds each year. Table 1 below shows data from samples of 5 and 15 birds randomly selected from the Grants’ complete set of measurements from nonsurvivors and survivors. Answer questions 5–8.



***Part D: Adaptive Traits and Constructing Graphs***

In addition to beak depth, Peter and Rosemary Grant collected dozens of other measurements, for example wing length and body mass. Table 3 below summarizes the mean and standard deviation of body mass and wing length for 50 birds that did not survive the drought and 50 birds that survived the drought. Answer questions 9-13.

